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(54) Position setting device

(57) A setting device for measuring accurately the axial position of a machine element (3) on a shaft (1), for example a hydraulically releasable hub as described in U.K. patent No. 1,574,421, comprises a rigid beam (44) parallel to the machine shaft and carrying a scale (45) of known electrical characteristics, along which a transducer head (46), having a retractable finger (53) for engaging a radial face (16) of the machine element, is slidable. The position of the finger with respect to one end of the scale is translated into a digital display.

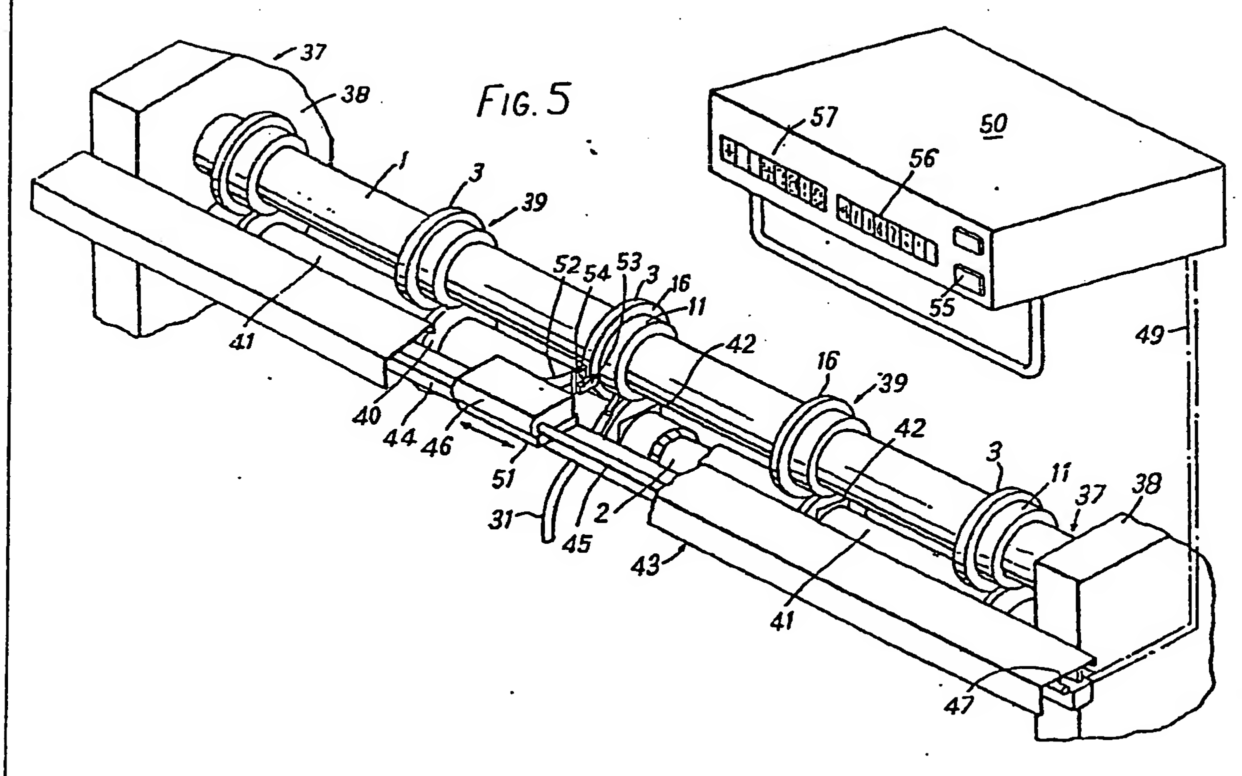

FIG. 5

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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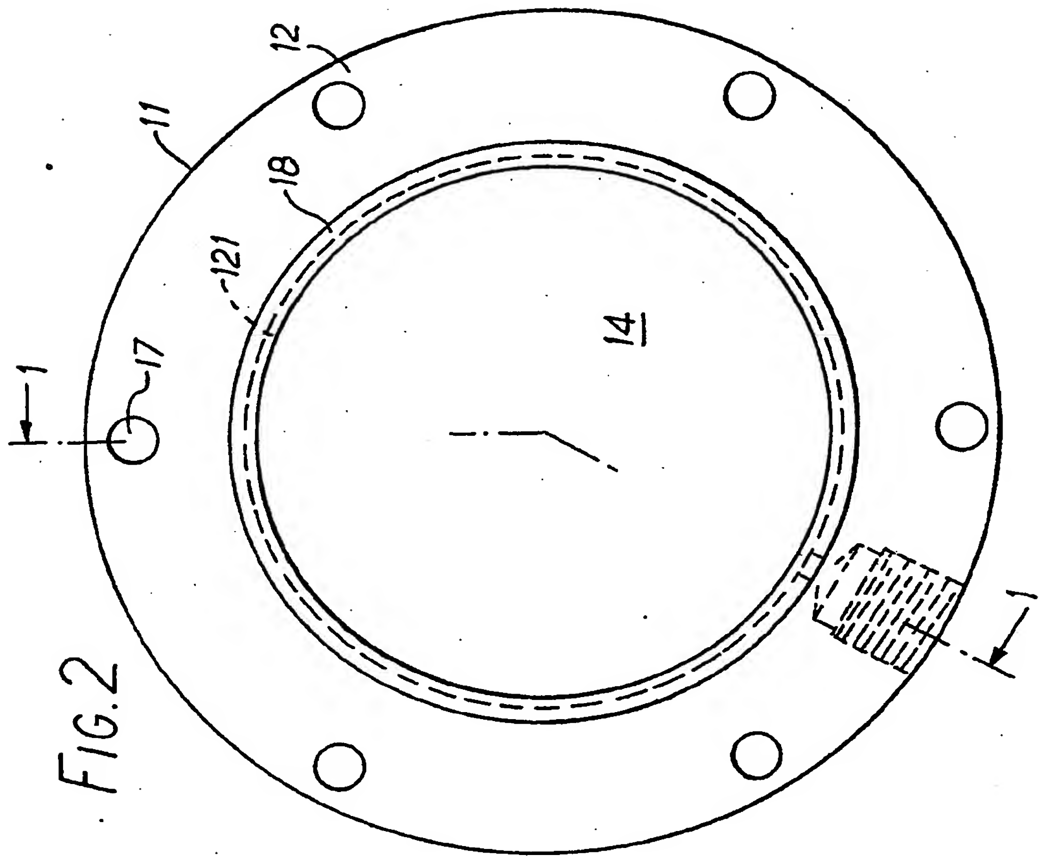

FIG. 2

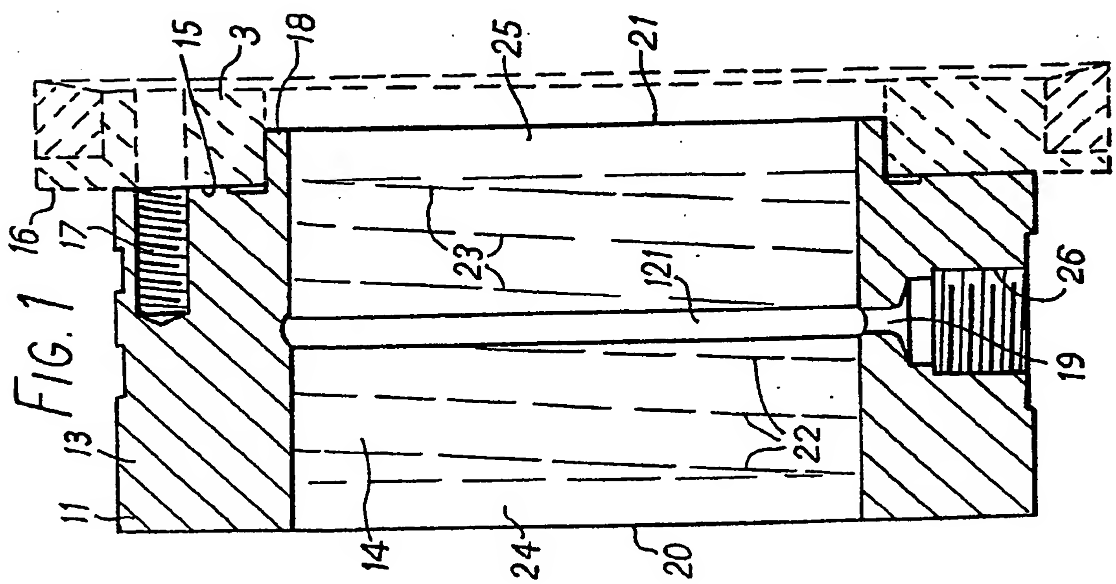

FIG. 1

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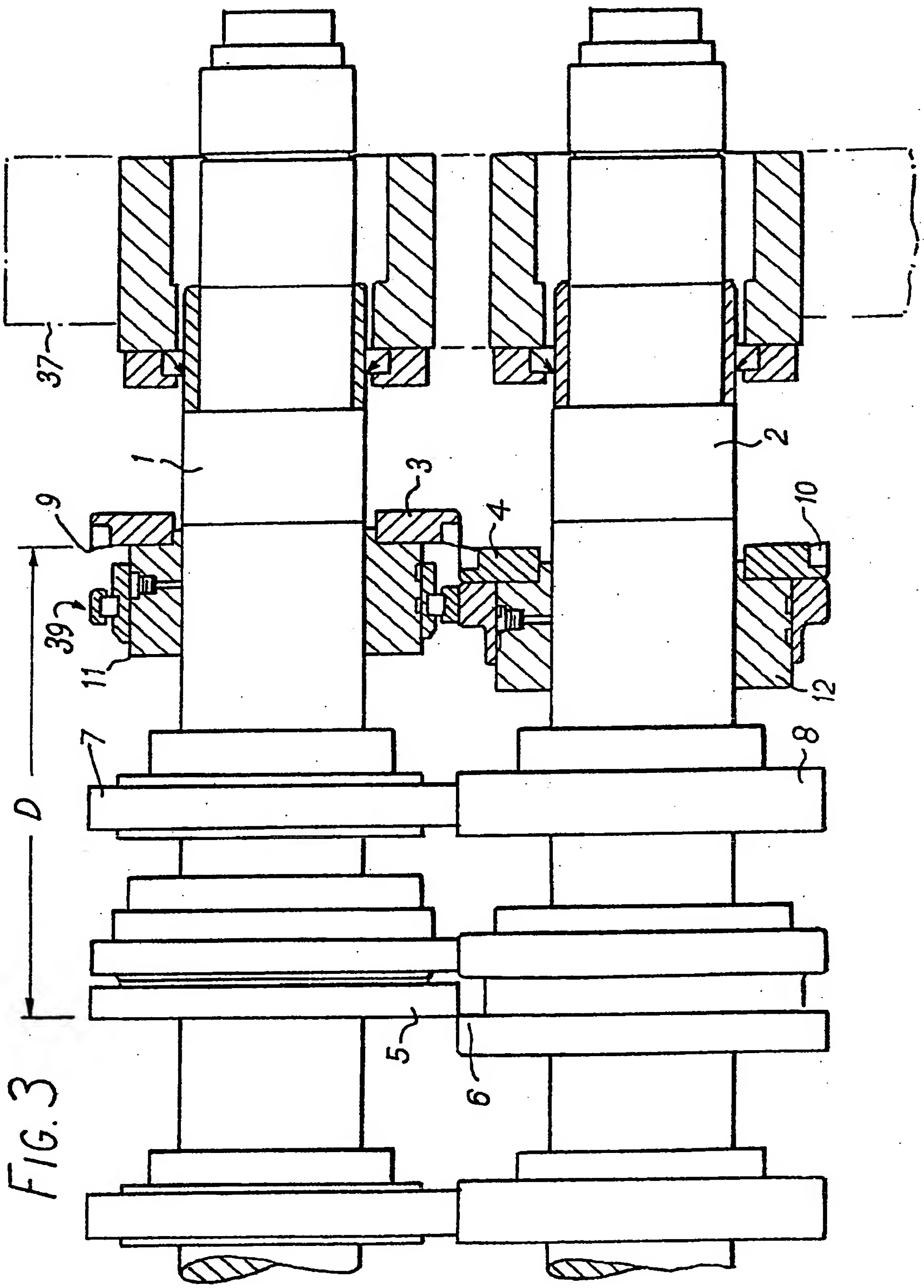
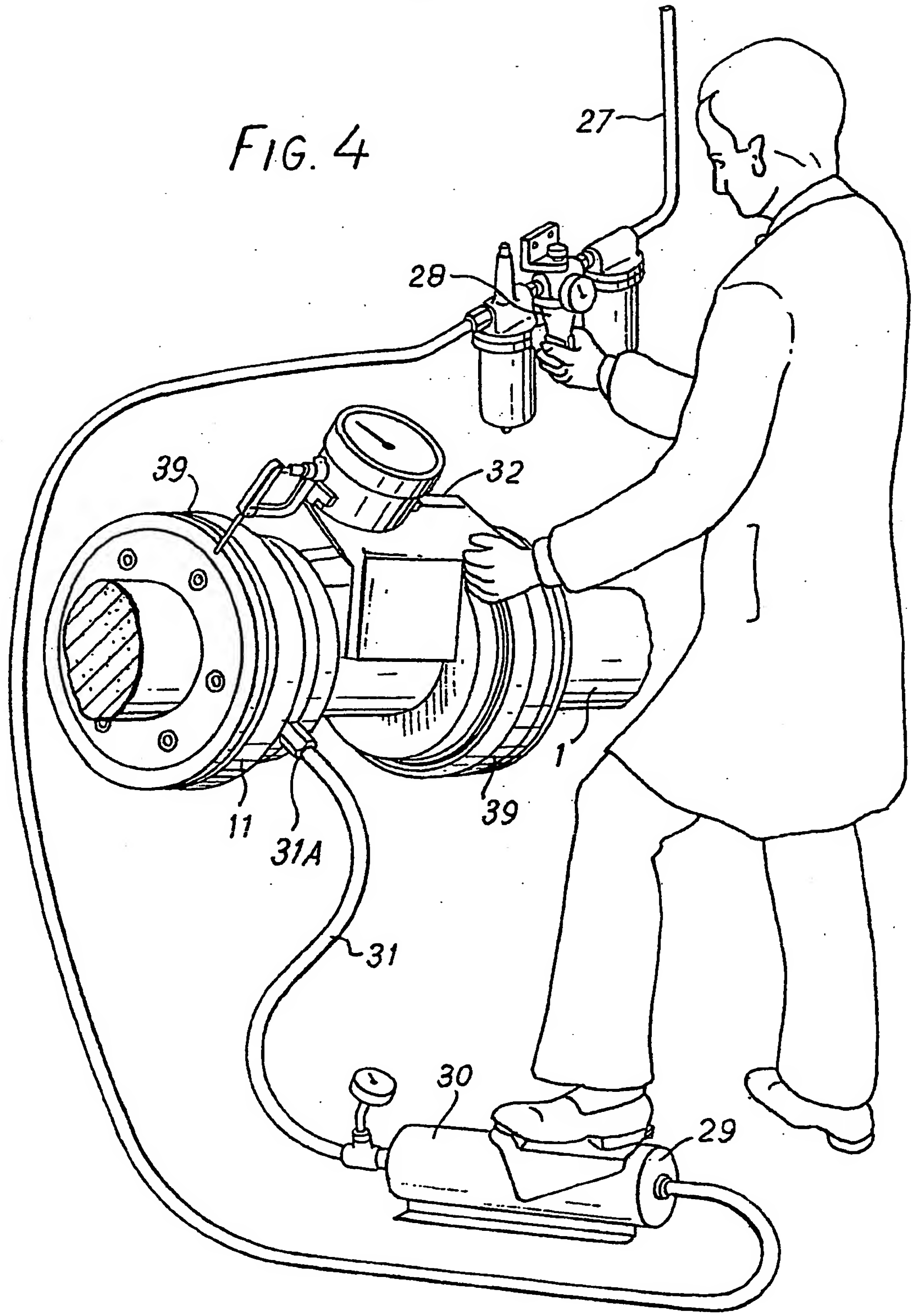


FIG. 3

FIG. 4



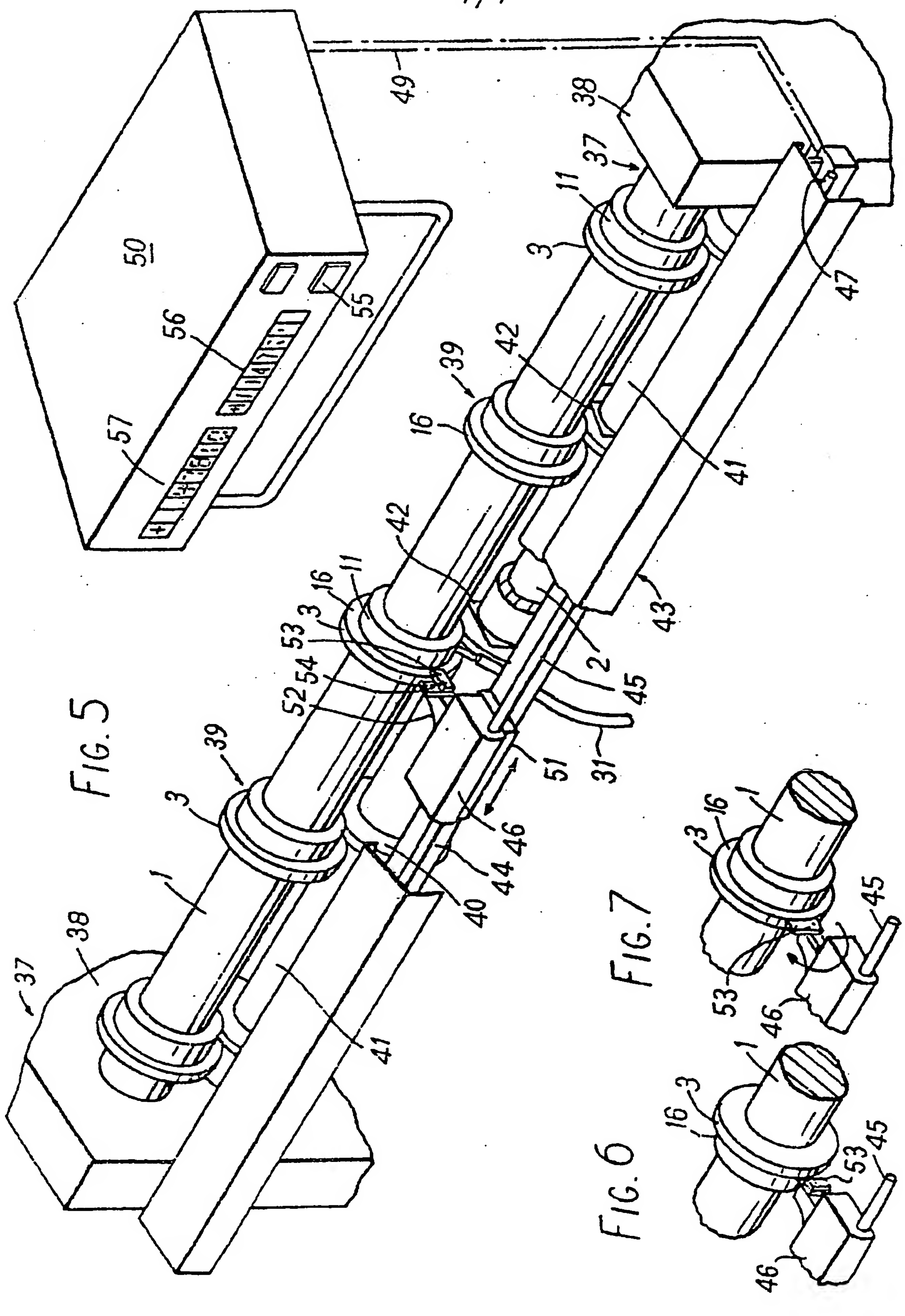


FIG. 5

FIG. 7

FIG. 6

SPECIFICATION
Position setting

This invention relates to apparatus and methods for setting the axial position of a machine element on a shaft.

Our United Kingdom patent specification No. 1,574,421 described a method of mounting upon a shaft of a machine a hub which is normally clamped to the shaft with an interference fit, but which is adapted to be radially expanded by application of hydraulic pressure at the interface between the hub and the shaft, so that the hub is free to be moved along the shaft for the purpose of setting it in a predetermined axial position.

Various means for measuring the axial position of such a hub (or indeed other machine elements mounted on shafts) are well known. One such, mentioned in the same patent specification No. 1,574,421, consists of a jig in the form of a gap gauge, with a dial gauge. Such jigs are expensive to make and to store. Furthermore, it is usually necessary to hold a number of jigs to allow for setting to a range of different predetermined settings. An alternative to this is a coventional vernier-type caliper gauge. All such mechanical devices are however very time-consuming, both in their setting-up and in actual use. Furthermore, their use requires some skill and they are found to give unreliable results when setting to a consistent accuracy of better than about 0.1 mm is called for. Indeed, in connection with the setting of the cutters fixed to hydraulically-adjustable hubs as described in our above-mentioned patent specification, variations of as much as 0.127 mm (0.005 in) have been detected. This necessitates tiresome and time-consuming re-setting of the cutters after trial strips of metal cut with the cutters have been measured.

Thus, whilst the invention of our patent No. 1,574,421 have provided a means for mounting a machine element on a shaft such that the former can be moved easily to any desired position, the accuracy of its actual setting is still dependent on the measuring equipment used in the setting operation, and such accuracy has not hitherto been sufficiently good to enable the potentiality of the said invention to be fully realised.

There is accordingly a need for a setting device capable of measuring the position of a machine element on a shaft with improved accuracy; which can be used by a semi-skilled person; which does not necessitate subsequent re-setting to adjust for inaccuracies; and which is "universal" in the sense that a simple setting device can be used to establish settings within a wide range of possible positions of the machine element, so that a single setting device can be supplied instead of, say, a set of jigs.

According to the invention in a first aspect, a setting device, for use in setting the axial position of a machine element on a shaft, comprises a linear scale of known electrical characteristics, a transducer head slidable along the scale, a rigid beam carrying the linear scale parallel therewith and adapted to be fixed to a fixed frame of the machine, the transducer head having an element adapted to engage the machine element, and electrical readout means responsive to the position of the transducer head along the scale to indicate the position of the machine element on the shaft.

In a preferred form of such setting device, the transducer head element comprises a finger having a pair of side faces extending in planes perpendicular to the scale, for engaging a radial face of a machine element carried on the shaft.

According to the invention in a second aspect, a method of setting the axial position of a hydraulically-mounted hub, having a radial face, on a shaft of a machine having a setting device according to the said preferred form, attached with its scale parallel to the shaft, comprises forcing a fluid under pressure into the interface between the bore of the hub and the shaft so as radially to expand the hub; engaging the finger of the setting device with the said radial face of the hub; moving the hub axially until the readout means indicates that the radial face is in its required position; and releasing the fluid pressure so that the hub becomes firmly fixed upon the shaft in its said position.

An embodiment of the invention will now be described, by way of example only, with reference to the drawings hereof, in which:

Figure 1 is a side elevation of a hydraulically-mounted hub according to patent application No. 4803/76, in section of the line 1—1 of Figure 2;

Figure 2 is an end elevation of the same hub;

Figure 3 is a side elevation of part of a pair of shafts in a rotary slitting machine having a number of such hubs;

Figure 4 is a diagrammatic sketch showing a shaft with a pair of such hubs, together with apparatus of a known kind for setting the hubs on the shaft;

Figure 5 is a simplified isometric view of a shaft with five hydraulically-mounted hubs and a setting device according to the invention;

Figure 6 is a scrap view showing part of the setting device when a hub is reversed; and

Figure 7 is a similar view showing how the device can be adapted to move past a hub.

In a typical can making operation a sheet of tinplate of the order of 1 metre long by 1 metre wide is passed between the rotating shafts 1,2 of a slitting machine or slitter (part of which is indicated at 37 in Figure 3), so that each pair of cutters progressively cuts a strip from the sheet. The slitter itself may be of any known type and need not be described fully here. The pair of cutters 3,4 are used to trim the edge of the sheet (not shown), whilst further pairs of cutters, such as those denoted at 5,6, are located along the shaft at a distance equal to the width of the strips to be cut from the sheet. The sheet is pulled between the shafts 1 and 2 by rubber rollers such as those denoted 7 and 8.

In order that the cut edges of the strips produced shall be straight and burr-free, the

carbide cutting edges 9 and 10 of the cutters 3 and 4 respectively mut be in a plane perpendicular to the rotational axis of the shaft and axially located correctly with respect to each other. This is achieved by grinding the engaging faces of the cutters and the hubs flat before assembling them; the hub and cutter assemblies are then located on each shaft. The axial distance *D* between the cutting edges 9,10 of the first pair of cutters 3,4 and the cutting edges of the next pair of cutters 5,6 represents the strip width to be produced, and this distance is adjusted by sliding the hub and cutter assemblies along the shaft. Accurate adjustment of the location of the cutters on the shaft depends on the hub not being detrimentally distorted.

As seen in Figures 1 and 2, the hub 11 comprises a substantially cylindrical body 13 having an axial bore 14. The axis of the bore 14 is perpendicular to the ground face 15 of the right hand end of the body 13 as shown in Figure 1. The cutter 3 (drawn dotted) has a ground face 16, held in engagement with the ground face 15 by studs (not shown) engaging in threaded holes in the body 13, one of which holes is denoted 17. Fitting of the cutter 3 to the body 13 is aided by a cylindrical spigot which serves to centre the cutter 3 on the hub 11 before fixing.

In the hub 11 of Figures 1 and 2, a radial hole 19, located equidistant by the end faces 20,21 of the body 13, leads through the hub wall and into an annular groove 121 formed in the bore 14. The radial hole 19 and groove 121 serve to lead oil under pressure into the hub when it is fitted on a shaft. Shallow helical grooves 22, 23 are adapted to lead such oil from the annular groove 121 axially away from the groove 121 through the interface between the shaft 1 and hub 11. The grooves 22,23 terminate before reaching the ends of the axial bore to leave smooth cylindrical lands 24,25 at the ends of the hub.

The radial hole 19 has a screw thread 26 to receive the terminal union 31*A* of a high pressure oil pipe 31, Figure 4, for supplying fluid to the hub under high pressure.

The hub bore 14 is an interference fit on the shaft 1, and the hub is therefore fitted to the shaft in any known manner, such as by heating to expand it. Thereafter, fluid under high pressure is introduced through the radial hole 19 into the grooves 121, 22 and 23, so as to expand the hub radially, sufficiently to create radial clearance between the hub 11 and shaft 1, and so to permit axial adjustment of the position of the hub on the shaft.

Referring to Figure 4, a known type of setting device for setting the axial position of the hubs on the shaft 1 comprises an air line 27, controlled by a suitable regulator and connected to a pedal-operated pressure intensifier 29 acting upon a supply of oil contained in its reservoir 30; and the high-pressure oil pipe 31, shown connected to the hub 11. The setting device shown in Figure 4 has measuring means, in the form of a dial gauge and jig 32, to measure the axial spacing between the cutters.

Referring now to Figure 5, the frame 37 of a slitting machine for tinplate sheets includes a pair of rigidly mounted, fixed end caps 38 carrying the shafts 1 and 2. The upper shaft 1 has five cutters 3, each attached to a respective hub 11 to form a cutter unit 39. Each unit 39 is constructed and arranged in the same manner as has already been described with reference to Figures 1 to 3.

The lower shaft 2 has five cutters 40, each in the form of a disc mounted on the shaft and separated from the next cutter by a cylindrical spacer 41 in conventional manner, the spacers 41 being short enough to permit shims 42 to be inserted as necessary between the spacers 41 and the cutters 40, in order that the axial position of each of the latter may be adjusted with respect to the corresponding cutter 3 with which the cutter 40 co-operates to slit a sheet of tinplate, not shown. One spacer 41 is shown cut away in Figure 5 to reveal the shaft 2.

Figure 5 also shows the oil pipe 31 temporarily connected to one of the upper cutter units 39, this oil pipe being associated, in the manner already described with reference to Figure 4, with a pressure intensifier having an oil reservoir and connected to a controllable supply of air under pressure.

In order to set each cutter 3 at the correct axial position on the upper shaft 1 of the machine, for slitting strips of tinplate to a desired width, the setting device generally indicated at 43 in Figure 5 is temporarily attached to the machine. The setting device 43 comprises a rigid beam 44 which is secured removably to the end caps 38 of the machine frame and extends parallel to the shaft 1 over the full length of the latter. Attached to the beam 44, and extending parallel to it, is a scale 45 in the form of a bar on which a transducer head 46 is freely slidable. The scale 45 has known electrical characteristics; for example the variation in electrical resistance with distance along the scale from one end thereof is known accurately. One end 47 of the scale 45 is connected *via* a terminal block 48 and lead 49 to an electronic, digital read-out unit 50. The transducer head 46 can be of any known kind such that, in co-operation with the scale 45, movement of the head 46 along the latter transmits to the unit 50 an electrical signal which varies according to the position of the transducer head with respect to the end 47 of the scale. The transducer head rests firmly and slidably upon the rigid beam 44 of the setting device by means of a pad 51.

The transducer head 46 has a rigid arm 52 extending towards the upper shaft 1 of the machine. A finger 53 is pivoted, as indicated at 54, to the arm 52, and is in the form of a strip of material having two parallel side faces. The finger 53 is mounted so that its side faces are in planes exactly perpendicular to the scale 45 (and therefore to the axis of the shaft 1).

In operation, datum pre-set switches 56 on the display unit 50 are operated to cause the desired

width of a strip of tinplate to be displayed on the digital display, 57, of the unit 50. The transducer head 46 is moved along the scale 45 by hand until one side face of the finger 53 engages a radial end face 16 of one of the cutters 3. A datum pre-set button 55 on the display or readout unit 50 is depressed to establish this particular cutter as the datum with respect to which the positions of the remaining cutters 3 along the shaft 1 are to be set. The finger 53 is now pivoted backwards as shown in Figure 7 so that it can be moved past the cutter 3, and is engaged with the next cutter 3 as shown in Figure 5, again using the radial end face 16 of the latter. This second cutter is connected to the oil pipe 31, and oil is introduced into the interface between the hub 11 and shaft 1 as previously described so that the cutter unit 39 is free to be moved along the shaft. The cutter unit and finger 53 are accordingly so moved by hand until the reading obtained on the display 57 is zero. The oil pressure is now released, so clamping the cutter unit 39 to the shaft 1. The process may then be repeated for the remaining three cutter units 39, each one being set using as datum the adjacent unit 39 whose position has been previously set.

The oil pipe 31 can then be disconnected and the setting device 43 removed. The cutters 40 on the lower shaft 2 are then set to establish a predetermined axial spacing between each cutter 40 and the corresponding cutter 3, by use of the shims 42 in conventional manner.

By using a setting device such as the device 43, the cutters can be set to a predetermined position within 0.013 mm (0.0005 in).

Referring to Figure 6, this illustrates the finger 53 with its other side engaging the radial face 16 of a cutter 3 when the latter is mounted on the shaft in a position reversed from that shown in Figures 5 and 7. The method is however precisely the same whichever way the face 16 is orientated.

CLAIMS

1. A setting device for use in setting the axial position of a machine element on a shaft, the device comprising a linear scale of known electrical characteristics, a transducer head slidable along the scale, a rigid beam carrying the linear scale parallel therewith and adapted to be fixed to a fixed frame of the machine, the transducer head having an element adapted to engage the machine element, and electrical readout means responsive to the position of the transducer head along the scale to indicate the position of the machine element on the shaft.

2. A setting device according to Claim 1, wherein the transducer head element comprises a finger having a pair of side faces extending in planes perpendicular to the scale, for engaging a radial face of a machine element carried on the shaft.

3. A setting device according to Claim 2, wherein the finger is retractable towards the scale so that the transducer head may be moved past the machine element.

4. A method of setting the axial position of a hydraulically-mounted hub, having a radial face, on a shaft of a machine having a setting device according to Claim 2 or Claim 3 attached with its scale parallel to the shaft, the method comprising forcing a fluid under pressure into the interface between the bore of the hub and the shaft so as radially to expand the hub; engaging the finger of the setting device with the said radial face of the hub; moving the hub axially until the readout means indicates that the radial face is in its required position; and releasing the fluid pressure so that the hub becomes firmly fixed upon the shaft in its said position.

5. A setting device for use in setting the axial position of a machine element on a shaft, the device being constructed, arranged and adapted to operate substantially as hereinbefore described with reference to, and as illustrated in, Figures 5 to 7 of the drawings hereof.

6. A method of setting the axial position of a hydraulically-mounted hub having a radial face, on a shaft of a machine having a setting device according to any one of Claims 2, 3 or 5, the method being performed in a manner substantially as hereinbefore described with reference to Figures 4 to 7 of the drawings hereof.

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PN - GB2093189 A 19820825

TI - Position setting device

AB - A setting device for measuring accurately the axial position of a machine element (3) on a shaft (1), for example a hydraulically releasable hub as described in U.K. patent No. 1,574,421, comprises a rigid beam (44) parallel to the machine shaft and carrying a scale (45) of known electrical characteristics, along which a transducer head (46), having a retractable finger (53) for engaging a radial face (16) of the machine element, is slidable. The position of the finger with respect to one end of the scale is translated into a digital display.
<IMAGE>

EC - B26D7/26C2 ;G01B7/14

PA - METAL BOX CO LTD

AP - GB19810004920 19810217

PR - GB19810004920 19810217

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AN - 1982-L1658E [34]

TI - Position setter for cutter fixed to hydraulic hub - uses retractable finger slidably engaging radial face of machine element against scale translated to digital display

AB - GB2093189 The device is used in setting the axial position of a machine element on a shaft and has a linear scale of known electrical characteristics and a transducer head slidable along the scale. A rigid beam carries the linear scale parallel with it and is adapted to be fixed to a fixed frame of the machine, the transducer head having an element adapted to engage the machine element.

- An electrical readout is responsive to the position of the machine element on the shaft. Pref. the transducer head element comprises a finger having a pair of side faces extending in planes perpendicular to the scale, for engaging a radial face of a machine element carried on the shaft.(5/7)

IW - POSITION SET CUT FIX HYDRAULIC HUB RETRACT FINGER SLIDE ENGAGE RADI FACE MACHINE ELEMENT SCALE TRANSLATION DIGITAL DISPLAY

PN - GB2093189 A 19820825 DW198234 008pp

IC - B23D19/06 ;G01B7/14

MC - S02-A02A

DC - P54 S02

PA - (METB) METAL BOX CO LTD

IN - GINN K D; WOODS L

PR - GB19810004920 19810217